Evidence for a strongly bound K^-pp state populated in the $pp \to K^+\Lambda p$ reaction and the $\Lambda(1405)$ debate

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The simplest kaonic nuclear bound system, K^-pp, which was first predicted to be a quasi-stable state [1, 2], has been studied extensively in recent years. A detailed theoretical analysis, based on the ansatz that the $\Lambda(1405)$ resonance is an $I = 0$ $\bar{K}N$ quasi-bound state embedded in the $\Sigma\pi$ continuum, has shown that K^-pp has a molecule-like structure in which the K^- migrates between the two protons, causing a *super-strong nuclear force* [3, 4]. The strongly bound nature of K^-pp is also shown by recent Faddeev calculations [5, 6]. On the other hand, various theories based on chiral dynamics lead to a "weak" $\bar{K}N$ interaction and predict a shallow bound state accordingly [7, 8].

Very recently an evidence for a strongly bound K^-pp has been shown from existing experimental data of $p + p \to K^+ + \Lambda + p$ at 2.85 GeV taken by the DISTO spectrometer [9], supporting the prediction that the strongly bound K^-pp system with a short $p - p$ distance can be formed in a $p + p \to K^+ + K^-pp$ reaction with an enormously large sticking probability between $\Lambda(1405)$ and p [4]. We also discuss experimental data on K^-p, related to the current issue of "where is the K^-p state located, at 1405 or 1420?".

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